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(54) AN IMPROVED WASTE MATERIAL DISINTEGRATOR

(71) We, LINDEMANN MASCHINENFABRIK GmbH, a company organised under the laws of the Federal Republic of Germany of Erkrather Strasse 401, 4000 Dusseldorf, Federal Republic of Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

This invention relates to a disintegrator for disintegrating waste materials, especially waste paper.

Typically a disintegrator comprises a rotor revolving in a housing about a horizontal axis and equipped with shredding tools. The housing includes a chamber arranged above the rotor and having an inlet opening for the material to be disintegrated. The chamber is arranged to one side of a vertical plane passing through the axis of the rotoc on the same side as that on which the shredding tools move upwards. The disintegrator also includes an anvil edge arranged on the other side of the vertical plane containing the axis of the rotor with its edge lying in a plane also containing the axis of the rotor but being inclined between 0° and 25° to the vertical. The anvil edge is arranged at a particular distance from the beating circle of the shredding tools to give the desired degree of disintegration.

A disintegrator of this type is shown and described in West German laid open specification number 21 28 106. This specification describes a specially developed paper disintegrator for disintegrating waste paper-type material occurring in very differing forms, for example as loose sheets, packaging paper, newspapers, books, documents, banded bundles of paper or bales of newspapers and files, and cardboard and boxes of differing sizes and thickness. The material to be disintegrated arrives through the inlet opening into the region of the upwardly rotating half of the rotor and, on contact with the shredding tools is torn up or at least thrown upwards. Materials having a low bulk density, for example loose sheets and packaging paper are brought comparatively rapidly into the region of the anvil edge and are disintegrated at that edge to a degree determined by the separation between the anvil edge and the beating circle of the shredding tools. Materials having high bulk density, such as bundles of newspapers or documents, are, under certain circumstances, thrown upwards several times by the shredding tools and often strike the roof or the wall of the housing causing them to burst open and separate. The thus prepared material is then disintegrated at the anvil edge in the same way as that having a low bulk density initially.

The position of the anvil edge is of great importance to the disintegration operation and to ensuring trouble-free operation of the machine. The degree of disintegration of the processed material is determined by the separation of this edge and the beating circle, i.e., from the envelope formed by the shredding tools during rotation of the rotor. The angular positon of the anvil edge determines the effective draw-in angle between ths rotor and the side wall of the housing which faces the downwardly moving shredding tools. If the angle between the plane containing the anvil edge and the axis of the rotor and the vertical plane containing the axis of the rotor is substantially larger than the angular range between 0° and 25°, the mechanical draw-in action of the shredding tools is so large that the material to be disintegrated is drawn in abruptly into the wedge-shaped space between rotor and the housing wall. Dense materials e.g., bundles of newspapers, can then be caught by the draw-in action before they have been loosened and this results in over loading of the disintegrator and the rotor becoming

blocked. On the other hand, with the anvil edge on the one side of the vertical plane so that the angle between the two planes is negative the mechanical draw-in action of the shredding tools is theoretically zero and the draw-in occurs predominantly only by the air stream produced by the rotation of the rotor. This results in an uneconomic disintegrating performance since the disintegrator has a very low throughput.

The position of the plane containing the anvil edge in a range between 0° and 25° from the vertical has been found to be optimum in practice for the most favourable draw-in effect, but this is however only a compromise solution because the known device is not equally suited for the disintegration of all kinds of materials covered by the term "waste paper". In the disintegration of cardboard boxes and large areas of cardboard or heavy gauge paper difficulties occur because these materials have a tendency to arch against the side walls of the chamber above the rotor and form a bridge of waste material. A material bridge can also be produced by the shredding tools cutting into the walls of a box without moving the box itself, so that this rests upon the rotor. As a result of a material bridge, the feed of waste material to the disintegrating zone between the anvil edge and the beating circle is blocked so that the disintegrator must be taken out of operation until the bridge is removed, since bridges of this type can usually only be removed by breaking down the bridge manually or by cleaning out the chamber with the rotor stopped.

The aim of this invention is to provide a disintegrator in which, the formation of bridges during its operation can be overcome without adversely affecting the required degree of disintegration.

According to this invention a waste material disintegrator comprises a rotor mounted in a housing for rotation about a horizontal axis and equppped with shredding tools, a chamber within the housing having an inlet opening for the material to be disintegrated and being arranged above and mainly to one side of a vertical plane containing the rotor axis, in use, the shredding tools moving upwards on the one side of ths vertical plane containing the axis, and a pivotal member having a first anvil edge and a press face and being pivotal between two extreme positions in one of which the press face is substantially horizontal and the first anvil edge a predetermined distance from the beating circle of the shredding tools to give the required degree of disintegration, and in the other of which the press face is upright and a second anvil edge is present in the same rotor quadrant as the first anvil face, and the second anvil edge is the same predetermined distance from the beating circle of the shredding tools to give the same required degree of disintegration.

With such a machine it is possible, when necessary, to pivot the pivotal member which carries the first anvil edge away from the rotor, and possibly outside the housing chamber, thus exposing a greater area of downwardly moving shredding tools and removing one of the supports for the bridge of material formed above the rotor, so that the bridge collapses and its constituent material is picked up by the shredding tools. With the increase in the exposed area of downwardly moving tools, the draw-in effect of the rotor is considerably intensified, which is a great advantage in the disintegration of materials such as cardboard boxes which are the same as those that tend to form bridges. Thus this invention, whilst over-coming the defect of bridge-building in the material feed also produces in a surprisingly simple and advantageous manner a further positive effect of improving the draw-in action for those very materials which tend to form bridges. The second anvil edge furthermore guarantees that the required degree of disintegration takes place and prevents larger quantities of materials from being suddenly drawn into the space between rotor and housing side wall and causing a blockage as a result of the increased draw-in effect of the shredding tools with the pivoted member in this position. When the pivotal member is pivoted back into its starting position, the press wall acts as a rammer, pressing the material to be disintegrated towards the rotor and thus ensures that this material is picked up by the shredding tools and is disintegrated.

Preferably when the pivotal member is in its one extreme position, the second anvil edge and press wall are not used. In this case the second anvil edge is arranged on the pivotal member at a position which, in its other extreme position, is radially nearest to the rotor and projects towards the beating circle of the shredding tools to give the required degree of disintegration. In the one position of the pivotal member in which the first anvil edge takes place over the disintegration function, the second anvil edge preferably does not project into the housing chamber, but is pivoted outwards so that it is not subjected to any wear caused by the disintegration operation.

In another embodiment of the invention, the second anvil edge is permanently fixed to the housing wall facing towards the downwardly revolving shredding tools, and arranged beneath the pivotal member. This embodiment has the advantage that the second anvil edge always projects towards the beating circle of the shredding tools to ensure the required degree of disintegration. The disadvantage of the greater wear on the second anvil edge in this example is

offset by the simpler nature of the construction of the machine.

Three examples of disintegrators in accordance with this invention will now be described with reference to the accompanying drawings, in which :–

Figure 1 is a vertical section through the first example with the pivotal member in its one extreme position;

Figure 2 is a vertical section through the first example with the pivotal member in its other extreme position;

Figure 3 is a partial elevation in the direction of the arrow III in Figure 2;

Figure 4 is a vertical section through a second example;

Figure 5 is a vertical section through a third example with the pivotal member in its one extreme position; and,

Figure 6 is a vertical section through the third example with the pivotal member in its other extreme position.

All three examples are generally similar to all three consist of a housing 1 having a rotor 5 journalled in it for rotation about a horizontal axis 2 in the direction of an arrow 3 and carrying shredding tools 4. The drive for the rotor 5 is not shown. The housing 1 consists of two mutually facing, vertical lateral walls 6, between which the rotor 5 is journalled, a vertical side wall, facing towards the downwardly revolving shredding tools 4 and including an upper part 7 and a lower part 8, and a side wall 9 facing towards the upwardly revolving shredding tools 4. The housing is bounded at the bottom by a bottom plate 10, which initially extends horizontally, and then is uniformly curved around the rotor 5 to form the lower side wall portion 8.

The side wall 9 is inclined at an angle of approximately 30° to the vertical, so that the housing chamber 12 diverges upwards and lies generally to one side of a vertical plane containing the axis 2 of the rotor 5. As a result of the inclined position, the side wall 9 forms a filler slide 13 and terminates at the bottom approximately at the level of the rotor centre, just away from the beating circle 14 of the shredding tools 4. A filling opening 15 is provided at the top of the side wall 9 and the material to be disintegrated is fed in to the housing chamber 12 through the opening 15 by, for example, a conveyor belt 16. Below the side wall 9 a lateral discharge opening 17 for the disintegrated material, leads into a discharge chute 18, and a conveyor belt 19 is located beneath the chute 18.

In the first example of disintegrator the lateral wall facing towards the downwardly revolving shredding tools 4, between the upper wall portion 7 and lower wall portion 8 includes a pivotal member 20 of box form which is movable between two extreme positions and is pivotally mounted about a horizontal axis 21. It consists of a bent plate 23 having a press wall 22, which is welded to a curved cover sheet 24 and end or reinforcing webs 25 to form a hollow object. The corner of the pivotal member which, when the number is in one extreme position as shown in Figure 1, extends towards the beating circle 14, is formed by an anvil edge 26 which co-operates with the shredding tools 4, to disintegrate the waste material. The anvil edge 26 is located at a distance *a* from the beating circle 14, and this distance *a* is predetermined to give the required degree of disintegration. The portion of the cover sheet 24 which continues into the anvil edge 26 is inclined at 30° to the vertical when the pivotal member 20 is in its one extreme position. In addition, the pivotal member 20 includes a second anvil edge 27, which is formed by tips 28 of a series of shredding cams 29 which are fixed at intervals along the pivotal member 20.

The pivotal member 20 is arranged to be pivoted, by a mechanical or hydraulic drive (not shown) out of the one position, shown in Figure 1 in which the press wall 22 extends horizontally and the anvil edge 26 co-operates with the shredding tools 4, into its other extreme position, shown in Figure 2, in which the press surface 22 is uptight, and the second anvil edge 27 is moved towards the rotor 5 and is a distance *a* from the beating circle 14. To prevent material escaping out of the housing chamber 12 above the pivotal member 20, a stripper 31 is provided, which co-operates with the surface mf the cover sheet 24.

The upper edge of the lower wall portion 8 is castellated to allow the shredding cams 29 to pass through grooves 30 between the castellations. The pivotal member 20 extends, with sliding clearance, between the lateral walls 6 and is pivotally mounted on these walls by means of bearing flanges 32. The shredding cams 29 are uniformly distributed along the entire width of the pivotal member 20 and pass with slight clearance through the grooves 30.

In the second example the second anvil edge 33 is provided on a shredding cam 34. The edge 33 is situated at the same distance *a* from the beating circle 14 as the first anvil edge 26. The shredding cam 34 is fixed to the lower side wall portion 8 and extends between the lateral walls 6 and remains in this position permanently. This is the chief difference between the first and second examples.

In the third example a pivotal member is provided, which consists of a press plate 36 which is pivotally journalled at one end - at the right end in the Figures 5 and 6 – on an axis 37. The other end of the plate 36 is connected by a hinge 38 to a crank plate 39,

which in turn is pivotally journalled on an axis 40. The axis 40 can be adjusted in height by means of a drive, not shown, in vertical grooves 41 formed in the lateral walls 6 above the axis 37.

A plate 42, attached to the crank plate 39 includes a first anvil edge 43 which, in the one position of the pivotal member 35 shown in Figure 5, is at the distance *a* from the beating circle 14. A second anvil edge 44 is formed by tips 45 of shredding cams 46, fixed at distances one from another along the pivotal member 35. When the pivotal member 35 is pivoted into its other position shown in Figure 6, the shredding cams 46 and the castellated top of the lower side wall portion 8 are also at the distance *a* from the beating circle 14. The arrangement of the shredding cams 46 and the castellated top of the lower side wall portion 8 is similar to the first example.

The method of use of the three examples is similar and will now be described. Figures 1, 4 and 5 show the disintegrators in their one or normal operating positions. The material to be disintegrated is conveyed by the belt 16 through the filling opening 15 into the housing chamber 12 and falls onto the upwardly revolving shredding tools 4, which throw dense material upwards again and thereby have a tearing and loosening action on it. In particular, materials of high bulk density, such as bales and files of paper, are thrown several times against the side wall 7 or cover plate 11 and thereby opened up. The thus prepared material is then disintegrated in the zone between the beating tools and the anvil edge 26, 43 to a degree determined by the separation of the two, the distance *a*, and is further transported in the rotational direction of the rotor 5 towards the outlet opening 17, where it passes through the chute 18 and falls onto the conveyor belt 19 to be conveyed away.

The initially described draw-in effect upon the material to be disintegrated is also influenced by the angle y, which the face of the cover sheet 24 adjacent to the first anvil edge 26 makes with the vertical in the one extreme position. The angle y also corresponds to the inclination of the plate 42. The greater the angle y, the more material can escape upwards during disintegration and this decreases the draw-in effect. For an acute or even negative angle of y, the draw-in action is large, because the material to be disintegrated is positively guided between the two. Satisfactory disintegration results are obtained if the inclination of the part of the cover sheet 24 adjacent the anvil edge 26 of the plate 42 to the vertical is in a range from 10° to 50°.

If a bridge of the waste material forms in the housing chamber 12 above the rotor 5 and blocks the feed to the rotor, then in the first example the pivotal member 20 is pivoted into the other extreme position as shown in Figure 2. As a result, the support of one end of the bridge is removed so that the bridge collapses. Following this the pivotal member is again returned to its one extreme position and during the return movement the press wall acts as a rammer and finally breaks down any bridge of material which may not have collapsed and urges it towards the rotor 5. The ramming action of the press wall 22 is also exceedingly effective if cardboard boxes rest upon rotor 5, because the shredding tools 4 in these cases cut furrows into the material. When the press wall 22 is swung in, these cardboard boxes are pressed onto the rotor 5, so that they are taken by the shredding tools 4 and disintegrated.

The shredding cams 29 forming the second anvil edge 27 and fixed to the pivotal member 20 participate in the pivoting movements of it and, when it is moved into its other extreme position they are moved into the housing chamber 12. The second anvil edge 27 then moves towards the rotor 5 to the same distance *a* from the beating circle 14 as the first anvil edge 26. This arrangement ensures that all the material is disintegrated to the required degree and thereby prevents the material from causing a blockage of the rotor 5 in the wedge-shaped narrowing space 48 as a result of the low range mechanical draw-in effect of the shredding tools 4, or from leaving the device without being disintegrated.

The second anvil edge 27, in its active position, is situated in regard to the rotational direction of the rotor 5 behind the initially described optimum region of between 0° and 25° from the vertical. This is, however, unimportant, since it usually only comes into action in the disintegration of materials, especially cardboard boxes and large areas of cardboard, which tend to form bridges, and with these materials a somewhat greater draw-in effect of the shredding tools 4 is indeed required, and can be accommodated without there being a risk of blocking the rotor 5. Indeed, if cardboard boxes exclusively are supplied to the disintegrating device, then it can even be operated with the pivotal member 20 permanently in the other extreme position.

The functioning of the second example of the disintegrator differs from the above-described only in that the second anvil edge 27 is not pivoted into the housing chamber 12, but is permanently mounted on the inner side of the lower side wall portion 8.

The third example again operates in a similar manner to the first with the pivotal member 35 being pivoted by means of the crank plate 39 which is moved by a drive, not shown, with its axis 40 journalled in the

vertical grooves 41. To ensure that the pivotal member 35 returns to its one position the press wall 35, the hinge 38 and the axes 37 and 40 are not in alignment and thus the press wall 49 is not absolutely vertical in the other extreme position to avoid a dead-centre position, from which the pivoting of the press wall 35 into the normal position would not be possible.

WHAT WE CLAIM IS:–

1. A waste material disintegrator comprising a rotor mounted in a housing for rotation about a horizontal axis and equipped with shredding tools, a chamber within the housing having an inlet opening for the material to be disintegrated and being arranged above and mainly to one side of a vertical plane containing the rotor axis, in use, the shredding tools moving upwards on the one side of the vertical plane containing the axis, and a pivotal member having a first anvil edge and a press face and being pivotal between two extreme positions in one of which the press face is substantially horizontal and the first anvil edge extends in a plane containing the rotor axis and inclined at 0° and 25° to the vertical with the first anvil edge a predetermined distance from the beating circle of the shredding tools to give the required degree of disintegration, and in the other of which the press face is upright and a second anvil edge is present in the same rotor quadrant as the first anvil face, and the second anvil edge is the same predetermined distance from the beating circle of the shredding tools to give the same required degree of disintegration.

2. A waste material disintegrator according to claim 1, in which the second anvil edge forms a portion of the pivotal member and is moved away from the rotor when the press face is substantially horizontal.

3. A waste material disintegrator according to claim 1, in which the second anvil edge is fixed to the housing wall facing the downwardly revolving shredding tools beneath the pivotal member.

4. A waste material disintegrator according to claim 1, constructed substantially as described with reference to the accompanying drawings.

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5 SHEETS

Sheet 1

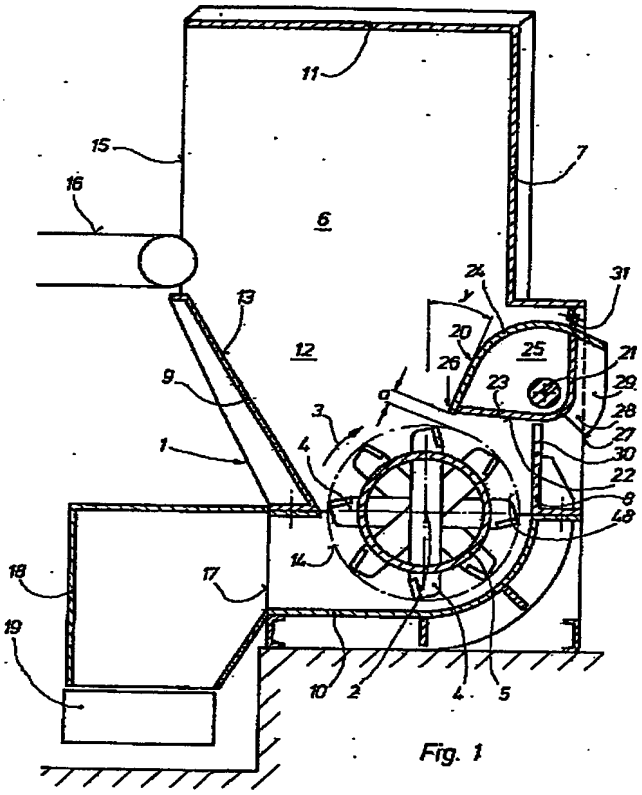


Fig. 1

Fig. 2

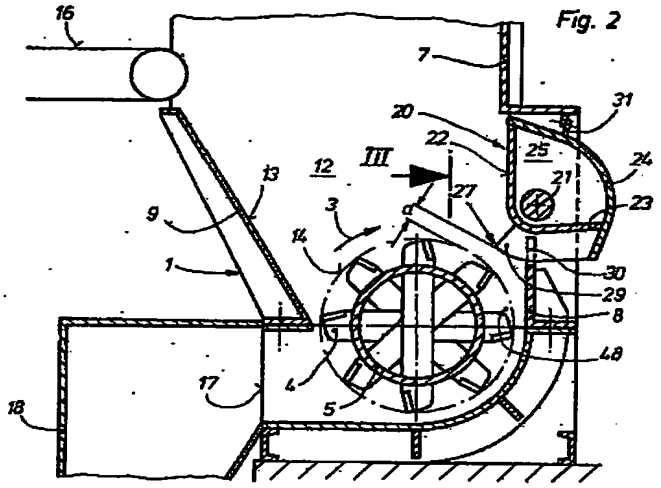
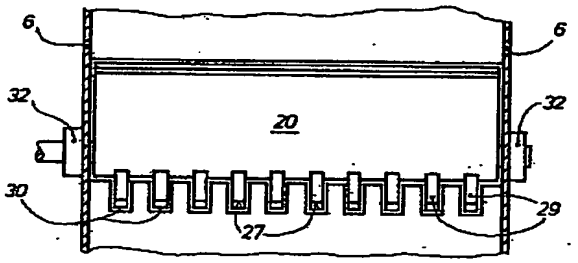


Fig. 3



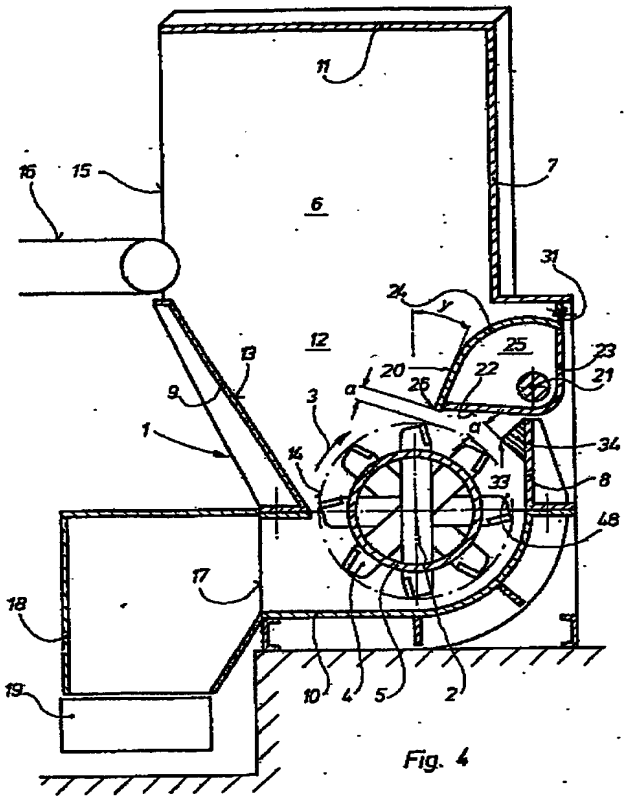


Fig. 4

1551176 COMPLETE SPECIFICATION
5 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 4

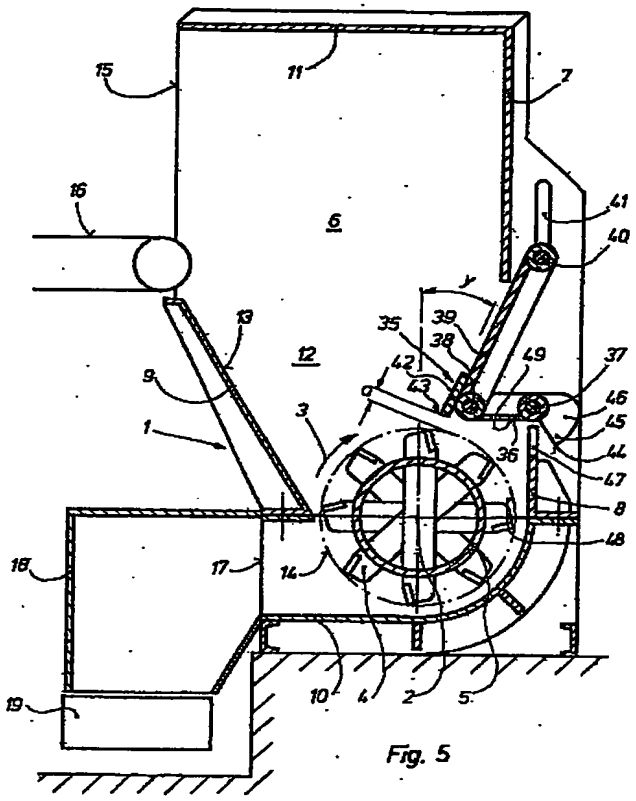


Fig. 5

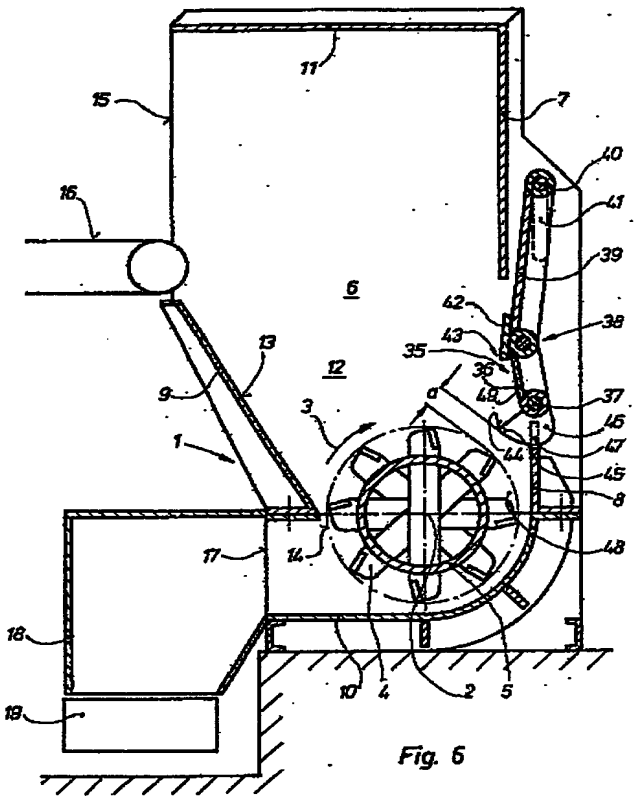


Fig. 6